USER MANUAL

NI SMD-7611/7612

This manual contains information about the configuration and use of the National Instruments SMD-7611 and SMD-7612. They are referred to inclusively as the NI SMD-7611/7612. Functionality on these devices are roughly equivalent. The NI SMD-7611 operates from 24 to 48 VDC, and has a running current of up to 4.5 A per phase. The SMD-7612 operates from 24 to 60 VDC, and runs current up to 7.8 A per phase.

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NATIONAL INSTRUMENTS

Safety Information

Only qualified personnel are permitted to transport, assemble, commission, and maintain this equipment. Properly qualified personnel are persons who are familiar with the transport, assembly, installation, commissioning and operation of motors, and who have the appropriate qualifications for their jobs. The qualified personnel must know and observe the following standards and regulations:

- IEC 364 resp. CENELEC HD 384 or DIN VDE 0100
- IEC report 664 or DIN VDE 0110
- National regulations for safety and accident prevention or VBG 4

To minimize the risk of potential safety problems, you should follow all applicable local and national codes that regulate the installation and operation of your equipment. These codes vary from area to area and it is your responsibility to determine which codes should be followed, and to verify that the equipment, installation, and operation are in compliance with the latest revision of these codes.

Equipment damage or serious injury to personnel can result from the failure to follow all applicable codes and standards. We do not guarantee the products described in this publication are suitable for your particular application, nor do we assume any responsibility for your product design, installation, or operation.

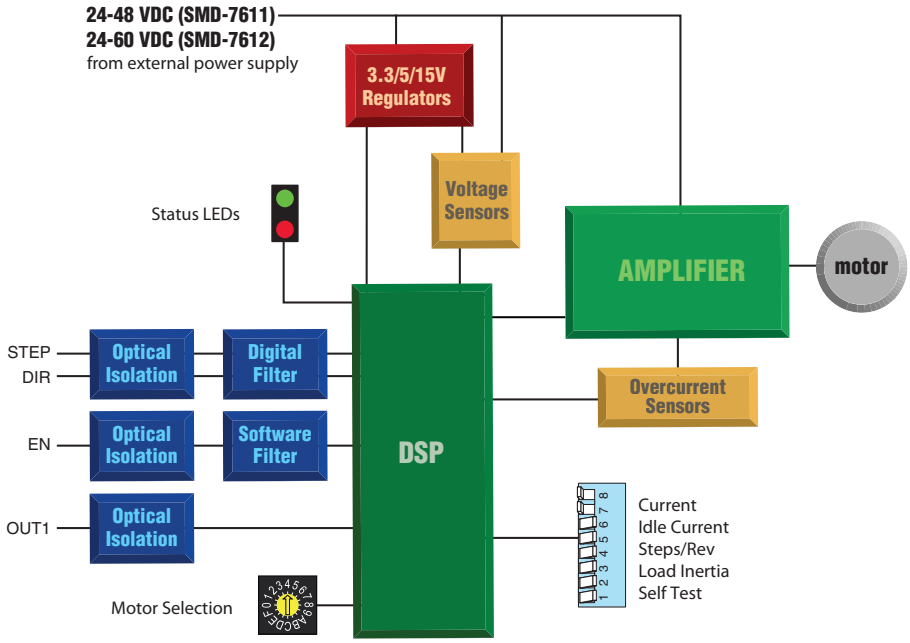
- Read all available documentation before assembly and commissioning. Incorrect handling of products in this manual can result in injury and damage to persons and machinery. Strictly adhere to the technical information on the installation requirements.
- It is vital to ensure that all system components are connected to earth ground. Electrical safety is impossible without a low-resistance earth connection.
- The STR2 contains electrostatically sensitive components that can be damaged by incorrect handling. Discharge yourself before touching the product. Avoid contact with high insulating materials (artificial fabrics, plastic film, etc.). Place the product on a conductive surface.
- During operation keep all covers and cabinet doors shut. Otherwise, there are deadly hazards that could possibility cause severe damage to health or the product.
- In operation, depending on the degree of enclosure protection, the product can have bare components that are live or have hot surfaces. Control and power cables can carry a high voltage even when the motor is not rotating.
- Never pull out or plug in the product while the system is live. There is a danger of electric arcing and danger to persons and contacts.
- After powering down the product, wait at least ten minutes before touching live sections of the equipment or undoing connections (e.g., contacts, screwed connections). Capacitors can store dangerous voltages for long periods of time after power has been switched off. To be safe, measure the contact points with a meter before touching.

Be alert to the potential for personal injury. Follow the recommended precautions and safe operating practices. Safety notices in this manual provide important information. Read and be familiar with these instructions before attempting installation, operation, or maintenance. The

purpose of this section is to alert users to possible safety hazards associated with this equipment and the precautions that need to be taken to reduce the risk of personal injury and damage to the equipment. Failure to observe these precautions could result in serious bodily injury, damage to the equipment, or operational difficulty.

Block Diagram

Figure 1. NI SMD-7611/7612 Block Diagram



Getting Started

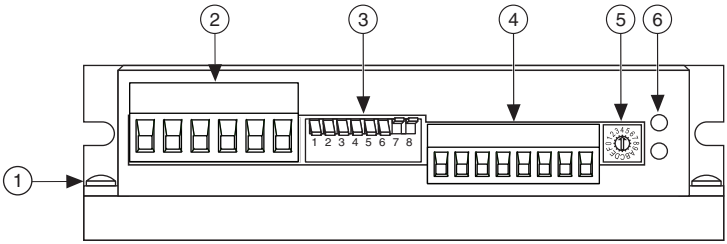
You need the following to use your NI SMD-7611/7612 stepper drive:

- ☐ a 12 to 48 VDC power supply (60 V max for NI SMD-7612). Refer to *Choosing a Power Supply* for help in choosing the right power supply
- ☐ one of the recommended motors
- ☐ a small flat blade screwdriver for tightening the connectors
- ☐ a source of step signals, such as a PLC or motion controller

The connectors and other points of interest are illustrated below. These are detailed later in the manual.

Figure 2 shows an overview of the connectors on the NI SMD-7611/7612 stepper drive.

Figure 2. NI SMD-7611/7612 Stepper Drive Connectors



1	Chassis Grounding Screw	4	Input and Output Signals
2	Motor and Power Supply Connector	5	Motor Selector Switch
3	Drive Configuration DIP Switches	6	Drive Status LEDs

Mounting the Drive

You can mount your drive on the wide or the narrow side of the chassis using #6 screws. If possible, the drive should be securely fastened to a smooth, flat metal surface that will help conduct heat away from the chassis. If this is not possible, then forced airflow from a fan may be required to prevent the drive from overheating. Refer to *Drive Heating* for more information.

- Never use your drive in a space where there is no air flow or where other devices cause the surrounding air to be more than 50 °C.
- Never put the drive where it can get wet or where metal or other electrically conductive particles can get on the circuitry.
- Always provide air flow around the drive. When mounting multiple drives near each other, maintain at least one half inch of space between drives.

Connecting the Power Supply

If you need information about choosing a power supply, refer to *Choosing a Power Supply*.

- Connect the power supply “+” terminal to the connector terminal labeled “V+”.
- Connect power supply “-” to the connector terminal labeled “V-”.
- The green ground screw on the corner of the chassis should be connected to earth ground.
- Use 18 or 20 gauge wire.

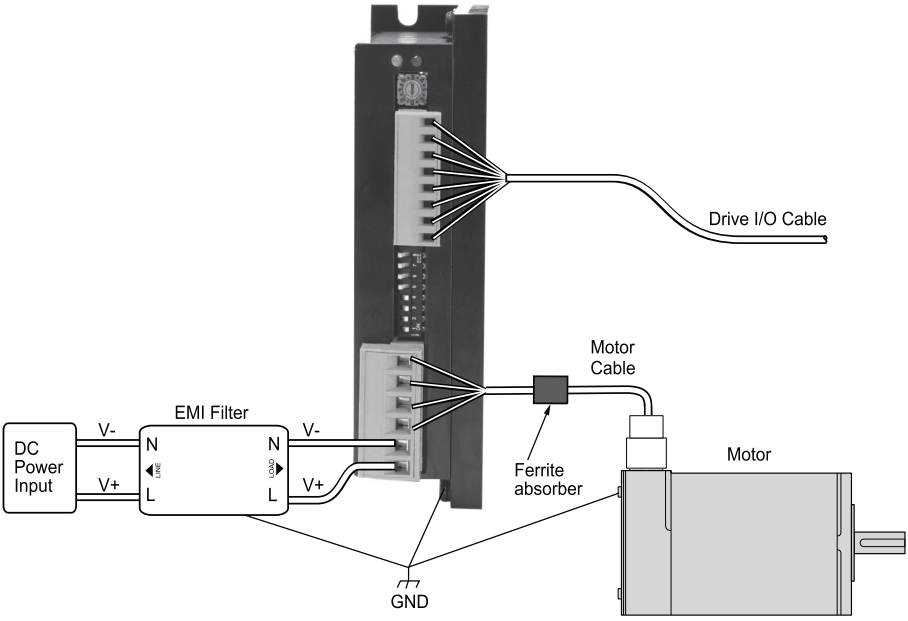
The NI SMD-7611/7612 drives contain an internal fuse that connects to the power supply + terminal. This fuse is not user replaceable. If you want to install a user serviceable fuse in your system, install a fast acting fuse in line with the + power supply lead. Use a 4 amp fuse for the SMD-7611 and a 7 amp fuse for the SMD-7612.

Caution Do not reverse the wires. Reverse connection will destroy your drive and void your warranty.

Drive CE Requirements

CE requires you to use an EMI line filter, installed as shown in the following figure.

Figure 3. An EMI Line Filter



If you plan to use a regulated power supply you may encounter a problem with regeneration. If you rapidly decelerate a load from a high speed, much of the kinetic energy of that load is transferred back to the power supply. This can trip the overvoltage protection of a switching power supply, causing it to shut down. NI offers the SMD-7700 regeneration clamp to solve this problem. If in doubt, buy an SMD-7700 for your first installation. If the regen LED on the SMD-7700 never flashes, you don't need the clamp.

Choosing a Power Supply

When choosing a power supply, there are many things to consider. If you are manufacturing equipment that will be sold to others, you probably want a supply with all the safety agency approvals. If size and weight are an issue, get a switching supply.

And you must decide what size of power supply (in terms of voltage and current) is needed for your application.

National Instruments offers two power supplies that are excellent matches for the NI SMD-7611/7612 drive: PS-12 24V, 6.3A) and PS-13 (48V, 6.7A).

Voltage

The motor can provide more torque at higher speeds if a higher power supply voltage is used. Refer to the *Torque Speed Curves* section for guidance.

If you choose an unregulated power supply, make sure the no load voltage of the supply does not exceed the drive's maximum input voltage specification.

Current

The maximum supply current you could ever need is two times the motor current. However, you will generally need a lot less than that, depending on the motor type, voltage, speed and load conditions. That's because the NI SMD-7611/7612 uses a switching amplifier, converting a high voltage and low current into lower voltage and higher current. The more the power supply voltage exceeds the motor voltage, the less current you'll need from the power supply. A motor running from a 48 volt supply can be expected to draw only half the supply current that it would with a 24 volt supply.

We recommend the following selection procedure:

1. If you plan to use only a few drives, get a power supply with at least twice per phase current rating of the step motor. Example: for a motor that's rated for 2 A/phase use a 4 A power supply.
2. If you are designing for mass production and must minimize cost, get one power supply with more than twice the rated current of the motor. Install the motor in the application and monitor the current coming out of the power supply and into the drive at various motor loads. This will tell you how much current you really need so you can design in a lower cost power supply.

Tables 1 and 2 list the maximum current required for each motor at several common power supply voltages. Please consider this information when choosing a power supply.

Table 1. NI SMD-7611 Power Supply Current

Switch	Motor	Drive Current (A), peak of sine	Max Power Supply Current (A)	
			24 VDC	48 VDC
0	Reserved for custom motors			
1				
2	ST17-4	2.4 parallel	1.6	1.7
3	ST17-1	1.6 parallel	1.1	1.1
4	ST17-2	2.0 parallel	1.1	1.1
5	ST17-3	2.0 parallel	1.1	1.1
6	ST23-1	3.4 parallel	1.9	2.0

Table 1. NI SMD-7611 Power Supply Current (Continued)

Switch	Motor	Drive Current (A), peak of sine	Max Power Supply Current (A)	
			24 VDC	48 VDC
7	ST23-4	4.5 parallel	3.2	3.3
8	ST23-6	4.5 parallel	3.2	3.4
9	ST24-1	3.36	2.6	2.3
A	ST24-2	4.5	5.2	3.2
B	ST24-3	4.5	4.3	3.4
C	ST34-2	4.5 series	2.6	2.5
D	ST34-5	4.5 series	2.4	2.7
E	ST34-1	3.816 series	2.1	2.1

Table 2. NI SMD-7612 Power Supply Current

Switch	Motor	Drive Current (A), peak of sine	Max Power Supply Current (A)		
			24 VDC	48 VDC	60 VDC
0	Reserved for custom motors				
1					
2					
3	ST23-8	6	4.4	4.0	4.0
4	ST23-1	3.4	1.9	2.0	N/A
5	ST23-4	5	3.2	3.3	N/A
6	ST23-6	5	3.2	3.4	N/A
7	ST24-1	3.36	2.6	2.3	2.0
8	ST24-2	4.8	5.2	3.2	2.7
9	ST24-3	4.8	4.3	3.4	2.9
A	ST34-2	8	5.1	5.0	5.0
B	ST34-5	8	5.2	4.6	4.4
C	ST34-8	8	5.2	5.4	5.3

Table 2. NI SMD-7612 Power Supply Current (Continued)

Switch	Motor	Drive Current (A), peak of sine	Max Power Supply Current (A)		
			24 VDC	48 VDC	60 VDC
D	ST34-1	7.56	4.8	4.2	4.0
E	ST34-4	7.56	4.4	4.2	4.2
F	ST34-7	6.72	3.5	3.2	3.3

Regeneration

When a motor rapidly decelerates from high speed under load, the kinetic energy may be reconverted into electrical energy and transferred back to the power supply. When using regulated power supplies, this can trip the overvoltage protection and lead to a shutdown, or cause damage to the system. Unregulated power supplies do not typically have overvoltage protection, and may store regenerated energy in capacitors.

System Wiring Recommendations

Maintain at least 2 in. separation between the power supply cable and input lines or encoder feedback. All power supply cables should be properly shielded, and the shield grounded at the power supply. Signal cables should be shielded, and grounded as close as possible to the signal source.

Connecting Motors

This section explains how to connect motors to the NI SMD-7611/7612. Refer to your motor documentation for any special considerations that may affect your configuration.

Caution Never connect or disconnect the motor while the system is powered on.

Note Ensure any shield or grounding strap on the motor is connected to the chassis ground screw located near the motor/power connector.

Figure 4. Motor/Power Connector

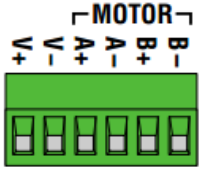


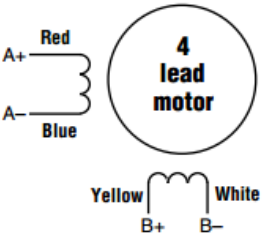
Figure 5. Grounding Screw on the Chassis

Four Lead Motors

Four lead motors can only be configured according to the following diagram.

Note Motor wire colors are correct for NI stepper motors compatible with the NI SMD-7611/7612. These wire colors may not match a third-party stepper motor.

Figure 6. Four Lead Motor Connection



Eight Lead Motors

Eight lead motors can be connected in series or parallel. A series connected motor needs less current than one that is connected in parallel but it will not be able to run as fast. Refer to the wiring diagrams below to connect an eight lead motor.

Figure 7. Eight Lead Motor Connected in Series

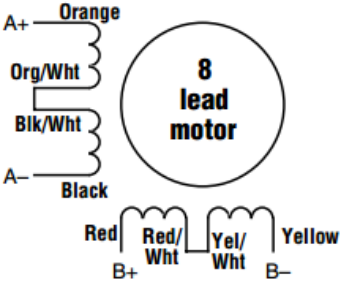
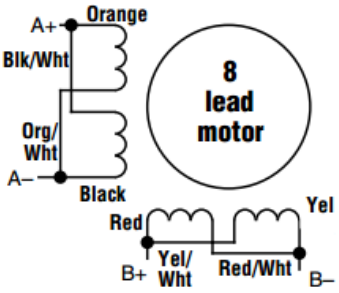


Figure 8. Eight Lead Motor Connected in Parallel



Connecting Input Signals

The NI SMD-7611/7612 has three input channels:

- STEP: A high-speed digital input for step pulse commends. 5-24 V logic.
- DIR: A high-speed digital input for the direction signal. 5-24 V logic.
- EN: A digital input for removing power from the motor. 5-24 V logic.

Note Activating then deactivating EN clears alarms and faults, and re-enables the motor in the case of drive faults.

Note STEP and DIR inputs can be converted to STEP CW and STEP CCW by configuring the internal jumper. Refer to *Step 6: Step Pulse Type* for more information.

Figure 9. Input Connector Pin Diagram

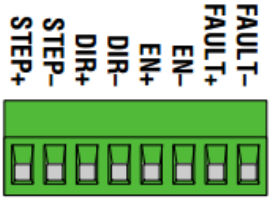
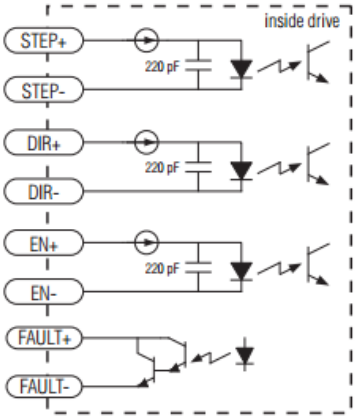


Figure 10. Input Connector Circuit Diagram



Connection Examples

The following section demonstrates example signal connections. Refer to *System Wiring Recommendations* for cable instructions.

STEP and DIR

Figure 11. Connecting to Indexer with Sourcing Outputs

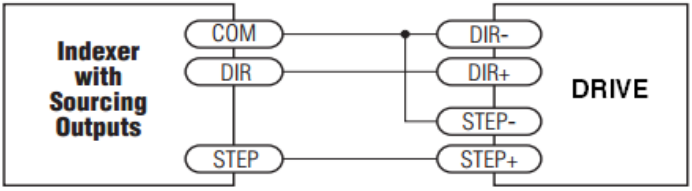


Figure 12. Connecting to Indexer with Sinking Outputs

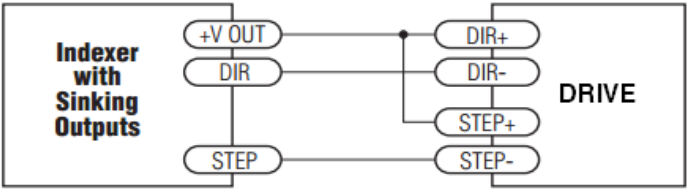
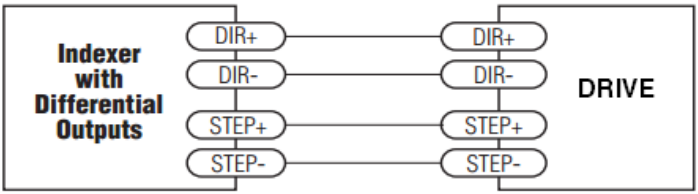


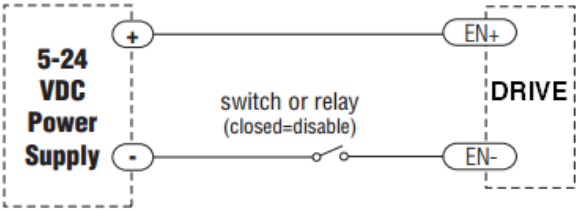
Figure 13. Connecting to Indexer with Differential Outputs



Enable Input

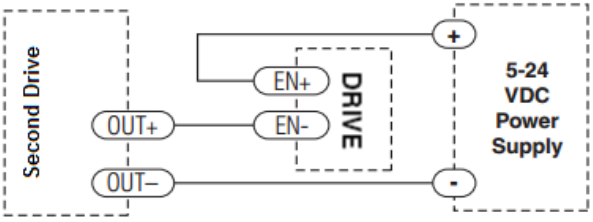
Connecting the Enable input as shown in Figure 14 causes the drive to disable when the relay is closed and enable when the relay is open.

Figure 14. Connecting Enable to a Switch or Relay



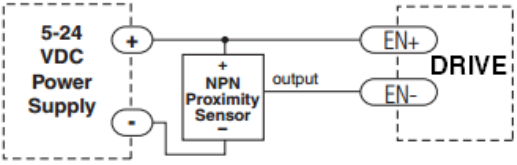
Connecting the Enable signal as shown in Figure 15 causes the drive to disable when the output closes.

Figure 15. Connecting a Second Drive to EN



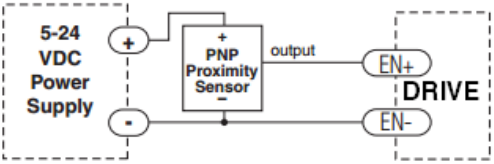
Connecting the Enable signal as shown in Figure 16 causes the drive to disable when the proximity sensor activates.

Figure 16. Connecting an NPN Type Proximity Sensor to an Input



Connecting the Enable signal as shown in Figure 17 causes the drive to disable when the proximity sensor activates.

Figure 17. Connecting a PNP Type Proximity Sensor to an Input



FAULT Output

The NI SMD-7611/7612 has a digital FAULT output. This output closes to signal a fault condition.

This output can be used to drive LEDs, relays, or the inputs of other electronic devices like PLCs. The "+" (collector) and "-" (emitter) terminals of the output transistor are available at the connector. This allows you to configure the output for current sourcing or sinking. Refer to the following diagrams to configure the FAULT output.

Caution Do not connect the output to more than 30 VDC. The current through the output terminal must not exceed 80 mA.

Figure 18. FAULT Output Circuit Diagram

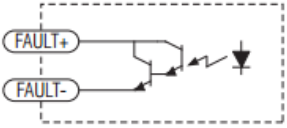


Figure 19. FAULT Output Configured for Sinking

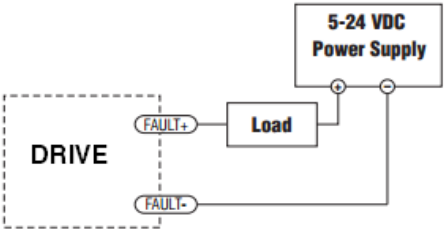


Figure 20. FAULT Output Configured for Sourcing

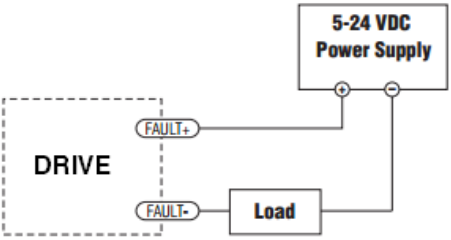
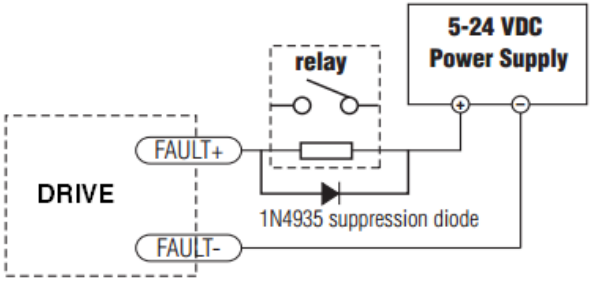


Figure 21. FAULT Output Driving a Relay



Configuring the Drive

This section contains a series of steps to configure the NI SMD-7611/7612.

Step 1: Selecting a Motor and Setting the Current

The NI SMD-7611/7612 is optimized for use with NI motors. To select a motor, move the rotary switch to the setting that corresponds to the motor of your choice. You can do this while power is on, but it is safer to select the motor before applying power to the drive so that you do not risk applying too much current to the motor.

Table 3. SMD-7611 Motor Specification Table

Model Number	Wiring	Drive Current (A), peak of sine	Holding Torque (oz-in.)	Rotor Intertia (g-cm^2)	Switch
Reserved for custom motors					0
					1
ST17-4	Parallel	2.4	113	123	2
ST17-1	Parallel	1.6	31.4	35	3
ST17-2	Parallel	2.0	51	54	4
ST17-3	Parallel	2.0	62.8	68	5
ST23-1	Parallel	3.4	76.6	120	6
ST23-4	Parallel	4.5	159.3	300	7
ST23-6	Parallel	4.5	237.6	480	8
ST24-1	4 leads	3.36	123	280	9
ST24-2	4 leads	4.5	166	450	A
ST24-3	4 leads	4.5	332	900	B
ST34-2	Series	4.5	585	1400	C
ST34-5	Series	4.5	1113	2680	D
ST34-1	Series	3.816 series	396	1100	E

Table 4. SMD-7612 Motor Specification Table

Model Number	Wiring	Drive Current (A), peak of sine	Holding Torque (oz-in.)	Rotor Intertia (g-cm^2)	Switch
Reserved for custom motors					0
					1
					2
ST23-8	Parallel	6	35.4	750	3
ST23-1	Parallel	3.4	76.6	120	4
ST23-4	Parallel	5	177	300	5

Table 4. SMD-7612 Motor Specification Table (Continued)

Model Number	Wiring	Drive Current (A), peak of sine	Holding Torque (oz-in.)	Rotor Intertia (g-cm^2)	Switch
ST23-6	Parallel	5	264	480	6
ST24-1	4 leads	3.36	123	280	7
ST24-2	4 leads	4.8	177	450	8
ST24-3	4 leads	4.8	354	900	9
ST34-2	Parallel	8	507	1400	A
ST34-5	Parallel	8	965	2680	B
ST34-8	Parallel	8	1439	4000	C
ST34-1	Parallel	7.56	396	1100	D
ST34-4	Parallel	7.56 series	849	1850	E

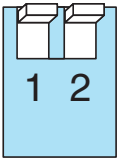
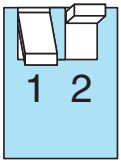
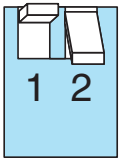
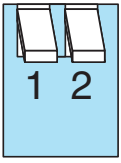
Step 2: Fine Tuning the Motor Current

The maximum current for the motor is set when the rotary switch is configured to select a motor. You may want to reduce the current to save power or lower motor temperature. This is important if the motor is not mounted to a surface that will help it dissipate heat or if the ambient temperature is expected to be high.

Step motors produce torque in direct proportion to current, but the amount of heat generated is roughly proportional to the square of the current. If you operate the motor at 90% of rated current, you'll get 90% of the rated torque, but the motor will produce approximately 81% as much heat. At 70% current, the torque is reduced to 70% and the heating to about 50%.

Switches 1 and 2 on the front of the SMD-7611/7612 drive are used to set the percent of rated current that will be applied to the motor. Refer to the table below to configure the switches.

Table 5. Configuring Current on Switch 1 and 2

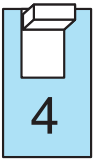
100%	90%	80%	70%
			

Step 3: Setting Idle Current

Motor heating and power consumption can also be reduced by lowering the motor current when it is not moving. The SMD-7611/7612 will automatically lower the motor current when it is idle to either 50% or 90% of the running current. The 50% idle current setting will lower the holding torque to 50%, which is enough to prevent the load from moving in most applications. This reduces motor heating by 75%. In some applications, such as those supporting a vertical load, it is necessary to provide a high holding torque. In such cases, the idle current can be set to 90% as shown below.

To set the idle current to 50%, place Switch 4 in the down position. To set the idle current to 90%, place switch 4 in the up position.

Table 6. Configuring Idle Current on Switch 4

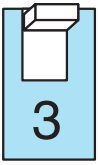
50%	90%
	

Step 4: Load Inertia

The SMD-7611/7612 includes anti-resonance and electronic damping features which greatly improve motor performance. To perform optimally, the drive must understand the electromechanical characteristics of the motor and load. Most of this is done automatically when you select the motor using the rotary switch. To further enhance performance, you must set switch 3 to indicate the approximate inertia ratio of the load and motor. The ranges are 0 to 4X and 5 to 10X. The motors table shown in Step 1 of this section includes the rotor inertia of each motor. Please divide the load inertia by the rotor inertia to determine the ratio.

Set switch 3 in the down position to configure a ratio of 5-10X. Set switch 3 in the up position to configure a ratio of 0-4X.

Table 7. Configuring Load Inertia on Switch 3

5 - 10X	0 - 4X
	

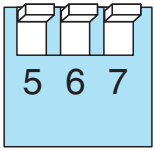
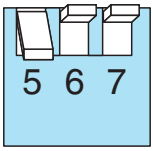
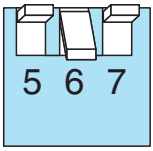
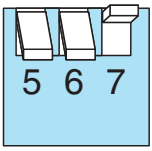
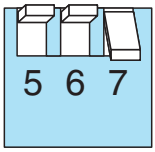
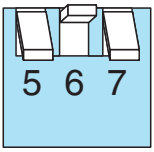
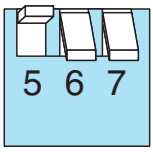
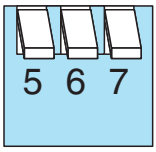
Step 5: Step Size

The SMD-7611/7612 requires a source of step pulses to command motion. This may be a PLC, an indexer, a motion controller or another type of device. The only requirement is that the device be able to produce step pulses whose frequency is in proportion to the desired motor speed, and be able to smoothly ramp the step speed up and down to produce smooth motor acceleration and deceleration.

Smaller step sizes result in smoother motion and more precise speed, but also require a higher step pulse frequency to achieve maximum speed. The smallest step size of the SMD-7611/7612 is 1/20,000th of a motor turn. To command a motor speed of 50 revolutions per second (3000 rpm) the step pulses frequency must be 50 × 20,000 = 1 MHz. Six different settings are provided in the SMD-7611/7612 drive, as shown in Table 8. Choose the one that best matches the capability of your system.

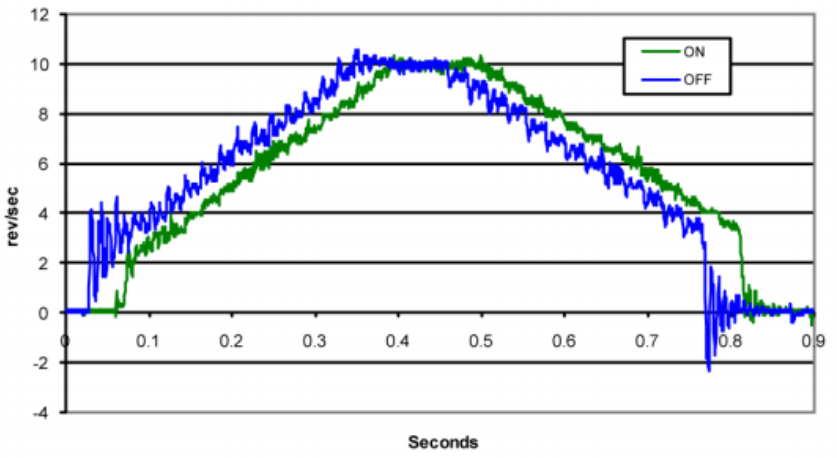
At lower step resolutions such as 200 steps/rev (full step) and 400 steps/rev (half step), motors run a little rough and produce more audible noise than when they are microstepped (2000 steps/rev and beyond). The SMD-7611/7612 drives include a feature called microstep emulation, or step smoothing, that can provide smooth motion when using full or half steps. By selecting 200 smooth or 400 smooth, this feature is automatically employed to provide the smoothest possible motion when using full or half stepping.

Table 8. Configuring Step Size on Switches 5, 6, and 7

Step/rev	20000	12800	5000	2000
Switch position				
Step/rev	400 Smooth	400	200 Smooth	200
Switch position				

Because a command filter is used as part of the step smoothing process, there will be a slight delay in the motion. If this delay is unsuitable for your application, please choose the non-filtered setting 200 or 400. The following figure shows an example of the delay that can occur from using the step smoothing filter.

Figure 22. Delay Due to Filtering

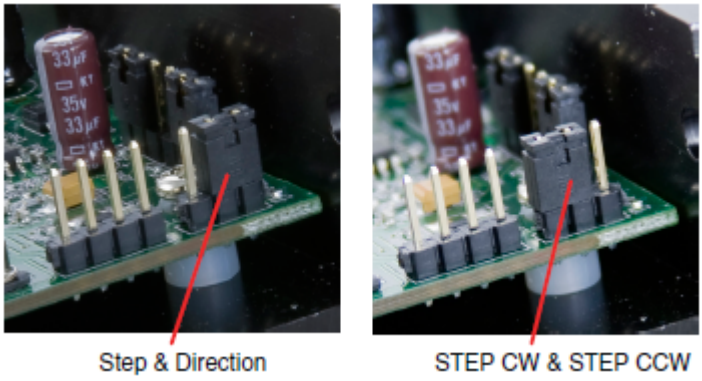


Step 6: Step Pulse Type

Most indexers and motion controllers provide motion commands in the Step and Direction format. The Step signal pulses once for each motor step and the direction signal commands direction. Some PLCs may use a different type of command signal: one signal pulses once for each desired step in the clockwise direction (STEP CW), while a second signal pulses for counterclockwise motion (STEP CCW). The SMD-7611/7612 drives can accept this type of signal if you remove the drive cover and move jumper S3 from the default position on pins 1 and 2 to the 1-3 position. In STEP CW/STEP CCW mode, the CW signal should be connected to the STEP input and the CCW signal to the DIR input.

Figure 23 shows the jumper positions.

Figure 23. Step Pulse Type Jumper Positions



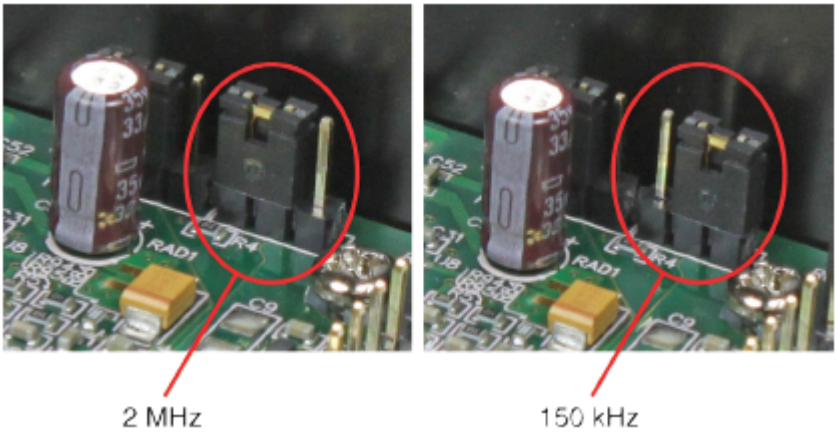
Step 7: Step Pulse Noise Filter

Electrical noise can affect the STEP signal in a negative way, causing the drive to think that one step pulse is two or more pulses. This results in extra motion and inaccurate motor and load positioning. To combat this problem, the drives include a digital noise filter on the STEP and DIR inputs. There are two settings for this filter: 150 kHz and 2 MHz. 150 kHz, the factory default, works well for most applications. If you are operating the SMD-7611/7612 at a high number of steps/rev and at high motor speeds, you may be commanding the drive at step rates above 150 kHz. In such cases, you should use the 2 MHz setting. The step noise filter is controlled by a jumper.

To set the filter frequency to 150 kHz, set the jumper as shown in Figure 24. To set the filter frequency to 2 MHz, set the jumper as shown in Figure 24.

Your maximum pulse rate will be the highest motor speed multiplied by the steps/rev. For example, 40 revs/second at 20,000 steps/rev is 40 × 20,000 = 800 kHz. Consider this when deciding if you must increase the filter frequency.

Figure 24. Step Pulse Noise Filter Jumper Positions

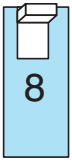


Step 8: Self Test

If you are having trouble getting your motor to turn, you may want to try the built-in self test. Any time switch 8 is moved to the ON position, the drive will automatically rotate the motor back and forth, 2.5 turns in each direction. This feature can be used to confirm that the motor is correctly wired, selected, and otherwise operational.

Table 9 shows the DIP switch positions.

Table 9. Configuring the Self Test Function on Switch 8

On	Off
	

Torque Speed Curves

Figure 25. Torque Curve for ST17 with SMD-7611 at 24 V

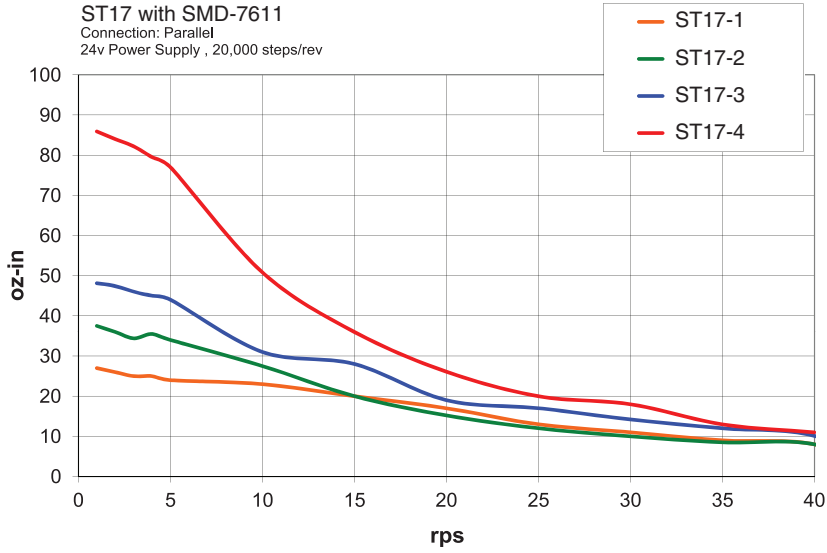


Figure 26. Torque Curve for ST17 with SMD-7611 at 48 V

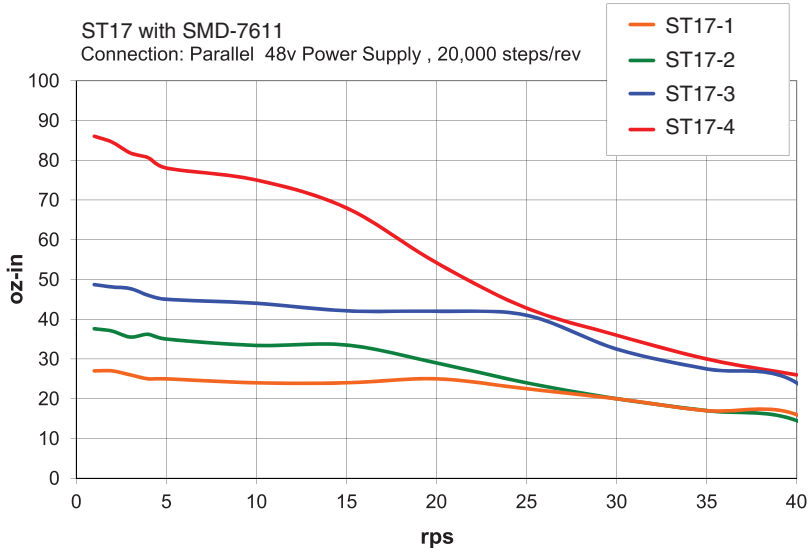


Figure 27. Torque Curve for ST23 with SMD-7611/7612 at 24 V

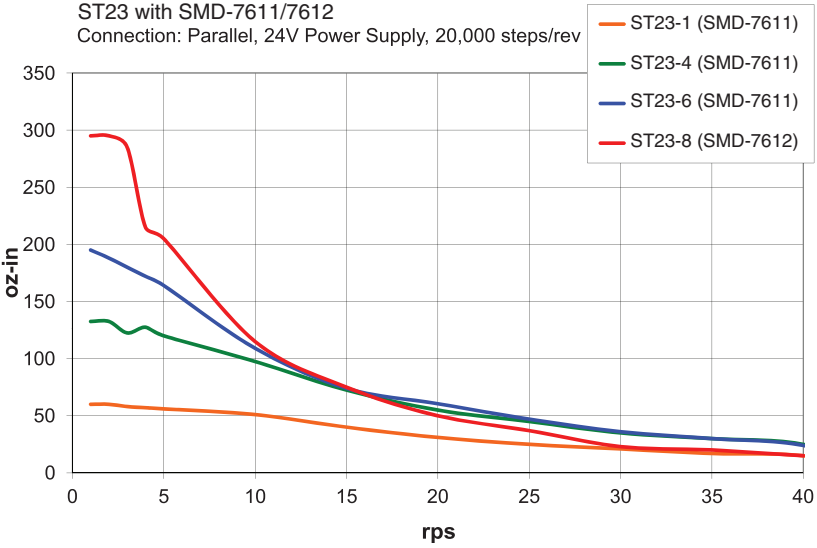


Figure 28. Torque Curve for ST23 with SMD-7611/7612 at 48 V

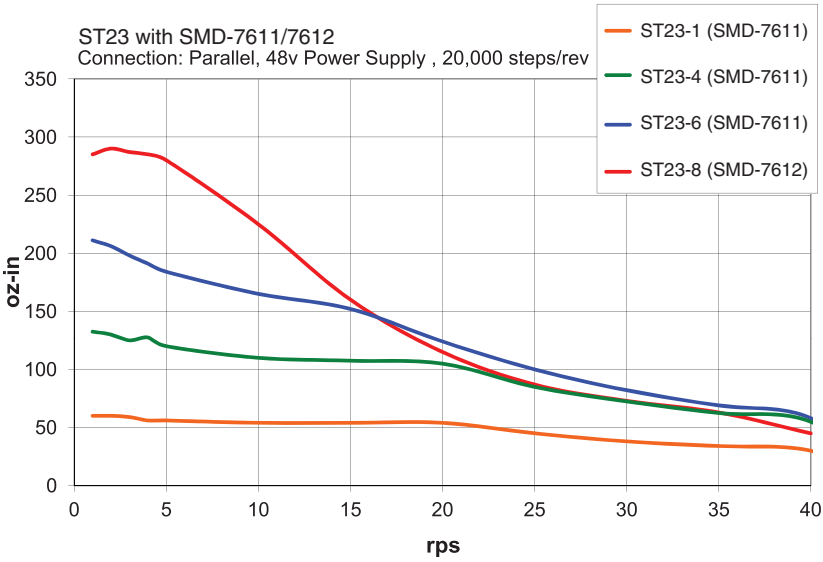


Figure 29. Torque Curve for ST24 with SMD-7612 at 24 V

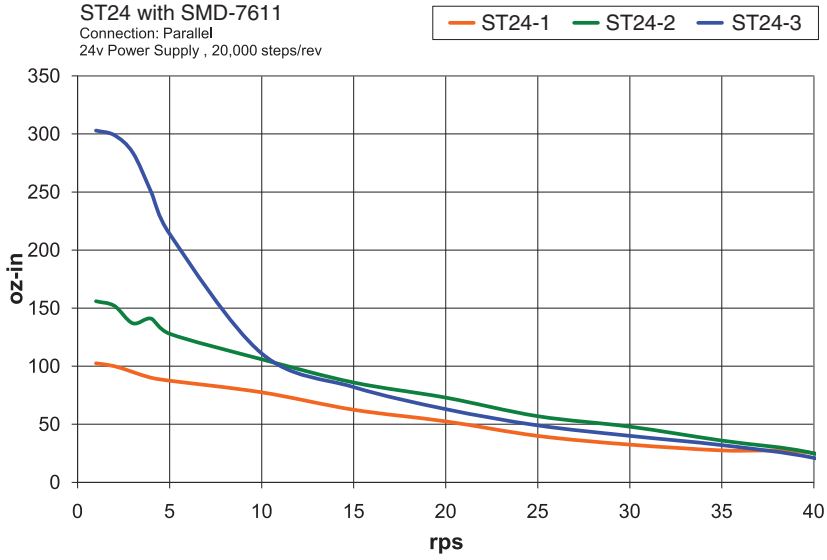


Figure 30. Torque Curve for ST24 with SMD-7612 at 48 V

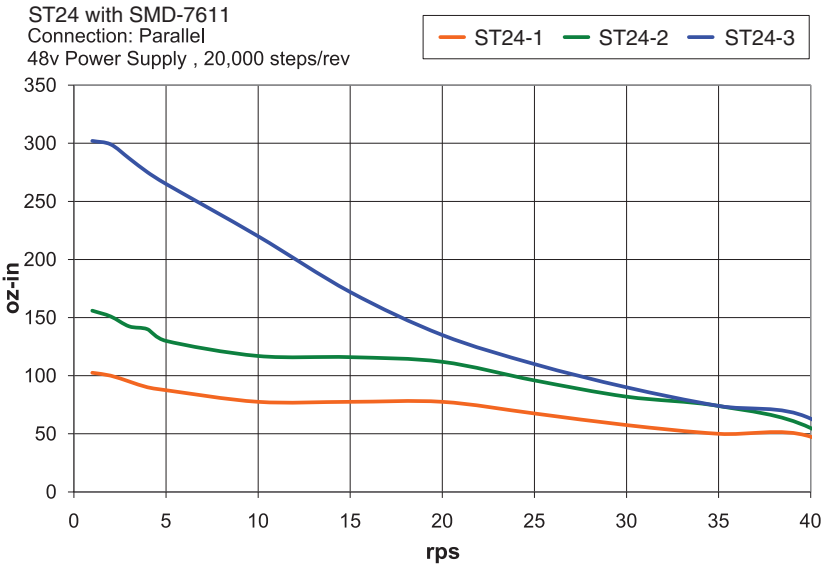


Figure 31. Torque Curve for ST34 with SMD-7611 at 48 V

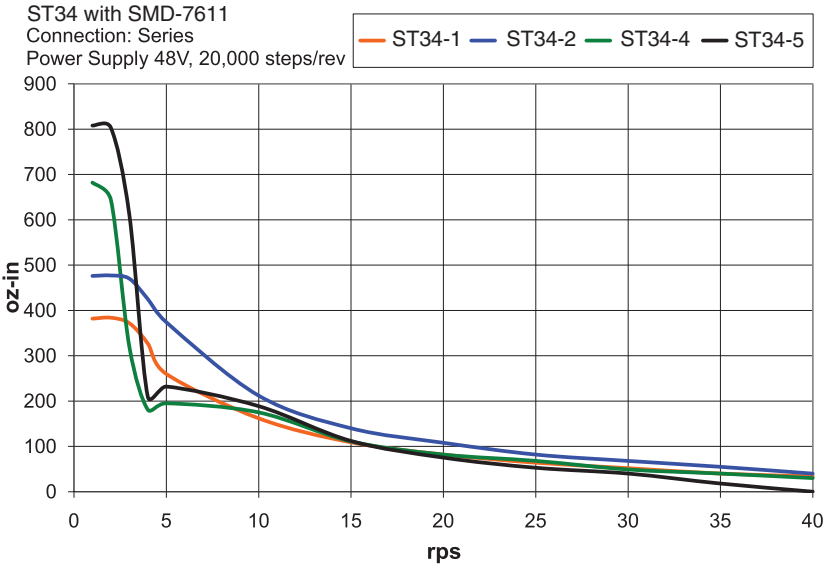


Figure 32. Torque Curve for ST34-1, ST34-4, and ST34-7 with SMD-7612 at 24 V

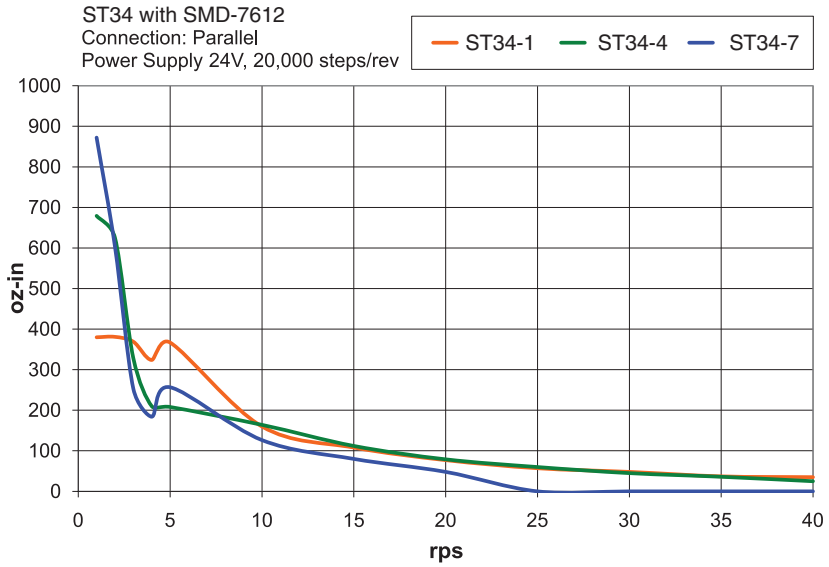


Figure 33. Torque Curve for ST34-1, ST34-4, and ST34-7 with SMD-7612 at 48 V

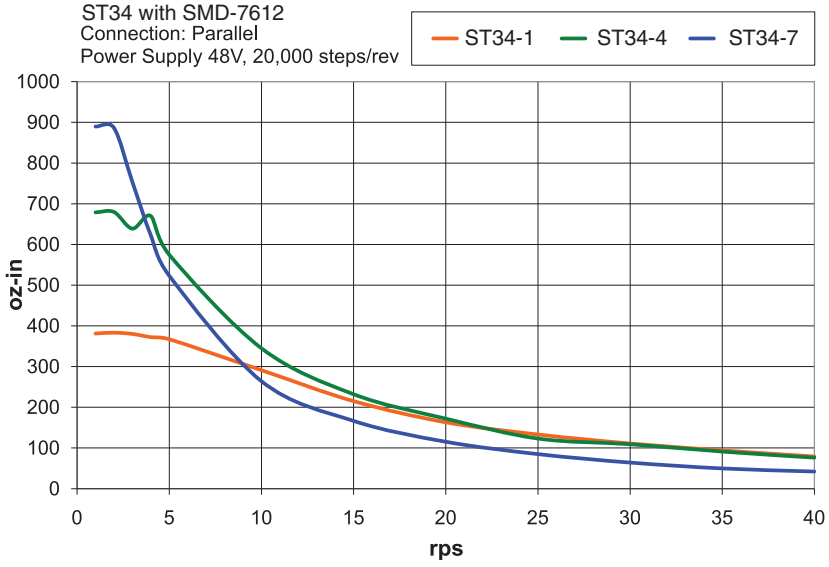


Figure 34. Torque Curve for ST34-1, ST34-4, and ST34-7 with SMD-7612 at 60 V

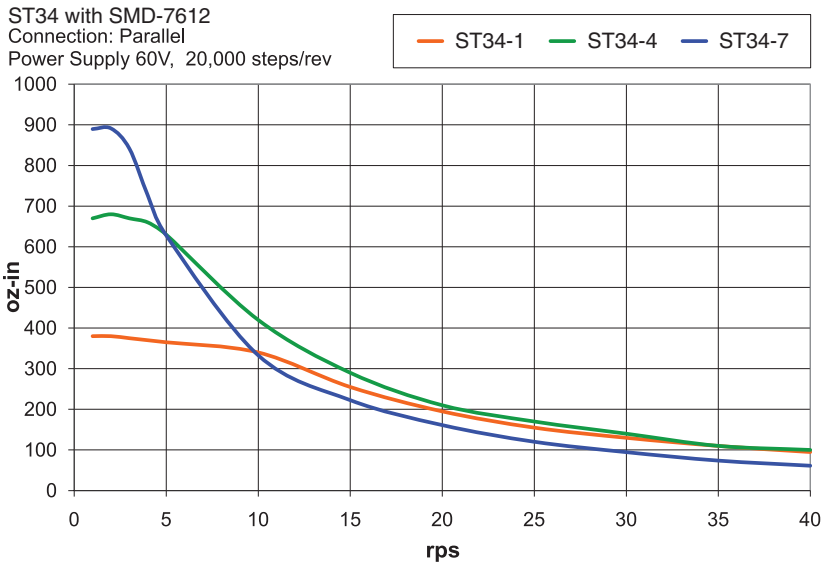


Figure 35. Torque Curve for ST34-2, ST34-5, and ST34-9 with SMD-7612 at 24 V

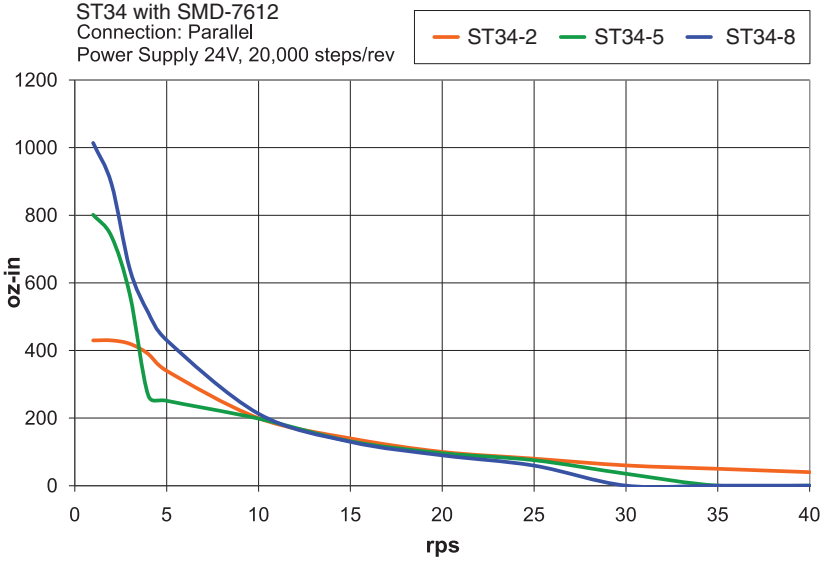


Figure 36. Torque Curve for ST34-2, ST34-5, and ST34-9 with SMD-7612 at 48 V

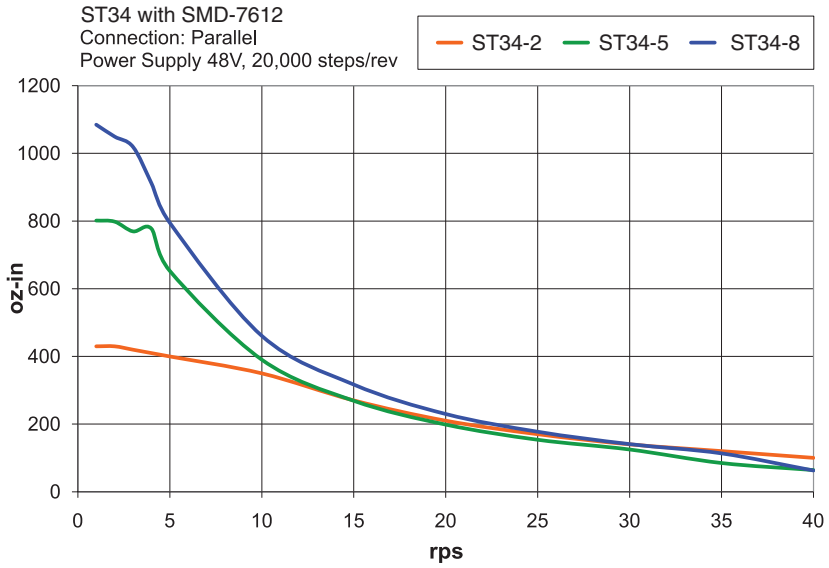
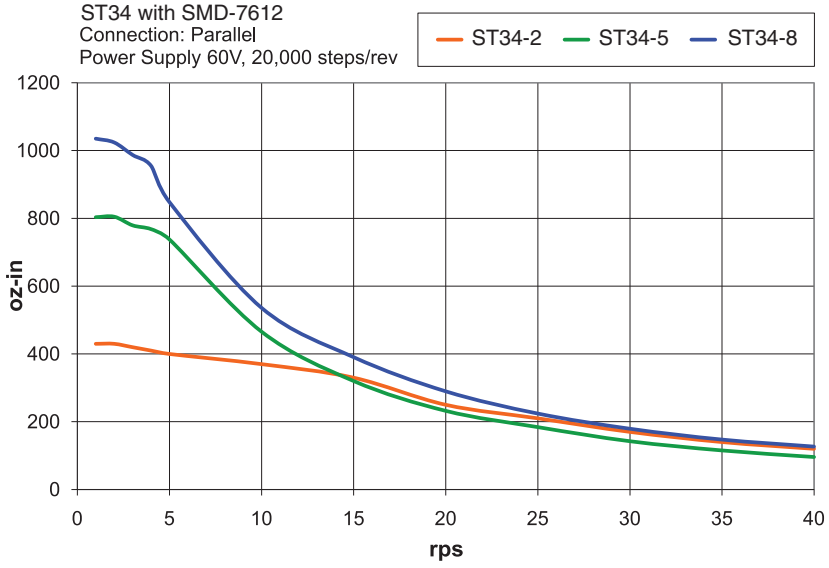


Figure 37. Torque Curve for ST34-2, ST34-5, and ST34-9 with SMD-7612 at 60 V



Motor Heating

Step motors convert electrical power from the driver into mechanical power to move a load. Because step motors are not perfectly efficient, some of the electrical power turns into heat on its way through the motor. This heating is not so much dependent on the load being driven but rather the motor speed and power supply voltage. There are certain combinations of speed and voltage at which a motor cannot be continuously operated without damage.

The following table and figures show the maximum duty cycle versus speed for each motor at commonly used power supply voltages. Please refer to this information when planning your application.

A step motor typically reaches maximum temperature after 30 to 45 minutes of operation. If you run the motor for one minute then let it sit idle for one minute, that is a 50% duty cycle. Five minutes on and five minutes off is also 50% duty. However, one hour on and one hour off has the effect of 100% duty because during the first hour the motor will reach full (and possibly excessive) temperature.

The actual temperature of the motor depends on how much heat is conducted, convected, or radiated out of it. Our measurements were made in a 40 °C (104 °F) environment with the motor mounted to an aluminum plate sized to provide a surface area consistent with the motor power dissipation. Your results may vary.

Table 10. SMD-7611 Maximum Motor Duty Cycle

Motor	Connection	Drive Current (A), peak of sine	Max Duty Cycle at 40 °C	
			24 VDC	48 VDC
ST17-1	Parallel	1.6	100%	See chart
ST17-2	Parallel	2	100%	See chart
ST17-3	Parallel	2	100%	See chart
ST17-4	Parallel	2.4	100%	See chart
ST23-1	Parallel	3.4	100%	See chart
ST23-4	Parallel	4.5	100%	See chart
ST23-6	Parallel	4.5	100%	See chart
ST24-1	4 leads	3.36	100%	100%
ST24-2	4 leads	4.5	100%	See chart
ST24-3	4 leads	4.5	100%	See chart
ST34-2	Series	4.5	100%	100%
ST34-5	Series	4.5	See chart	See chart
ST34-1	Series	3.816	100%	100%
ST34-4	Series	3.816	100%	100%

Table 11. SMD-7612 Maximum Motor Duty Cycle

Motor	Connection	Drive Current (A), peak of sine	Max Duty Cycle at 40 °C		
			24 VDC	48 VDC	60 VDC
ST23-1	Parallel	3.4	100%	See chart	See chart
ST23-4	Parallel	5	100%	See chart	See chart
ST23-6	Parallel	5	100%	See chart	See chart
ST23-8	Parallel	6	100%	See chart	See chart
ST24-1	4 leads	3.36	100%	100%	See chart
ST24-2	4 leads	4.8	100%	See chart	See chart
ST24-3	4 leads	4.8	100%	See chart	See chart
ST34-2	Parallel	8	100%	See chart	See chart
ST34-5	Parallel	8	See chart	See chart	See chart
ST34-8	Parallel	8	See chart	See chart	See chart
ST34-1	Parallel	7.56	100%	100%	100%
ST34-4	Parallel	7.56	100%	100%	See chart
ST34-7	Parallel	6.72	100%	100%	100%

Figure 38. Duty Cycle for the ST17-1 with the SMD-7611

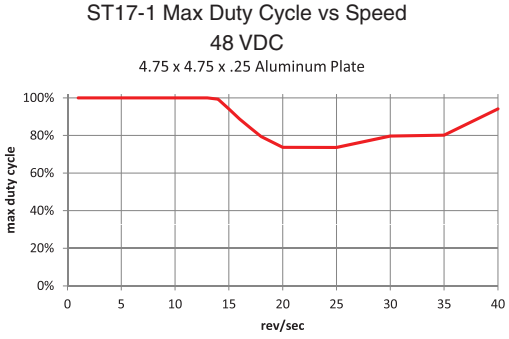


Figure 39. Duty Cycle for the ST17-2 with the SMD-7611

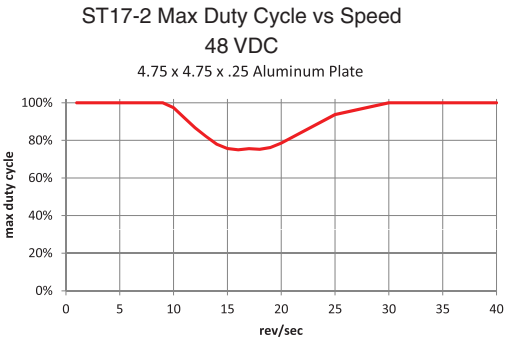


Figure 40. Duty Cycle for the ST17-3 with the SMD-7611

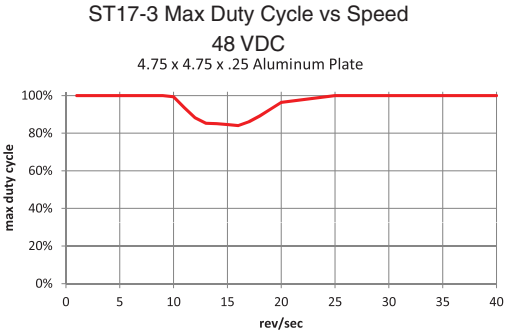


Figure 41. Duty Cycle for the ST17-4 with the SMD-7611

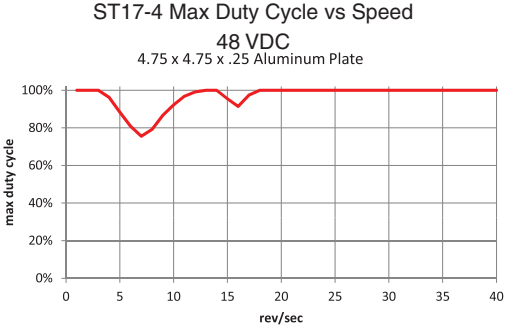


Figure 42. Duty Cycle for the ST23-1 with the SMD-7611

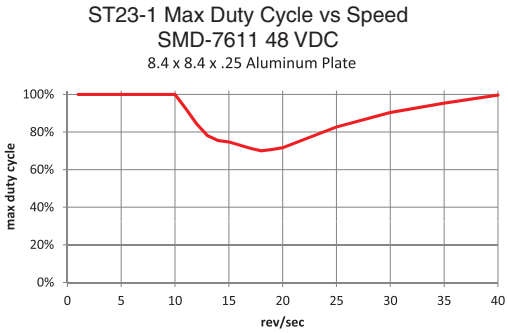


Figure 43. Duty Cycle for the ST23-1 with the SMD-7612

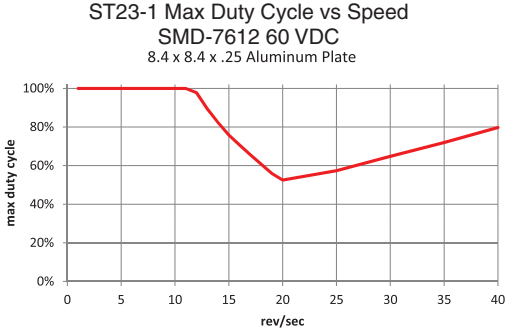


Figure 44. Duty Cycle for the ST23-4 with the SMD-7612 at 48 VDC

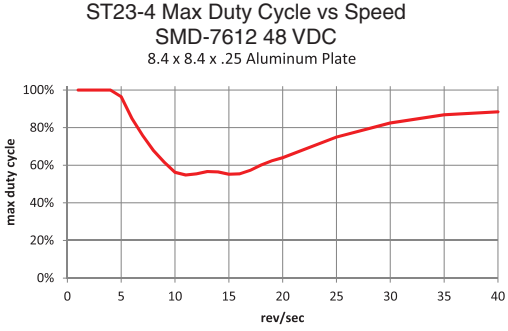


Figure 45. Duty Cycle for the ST23-4 with the SMD-7612 at 60 VDC

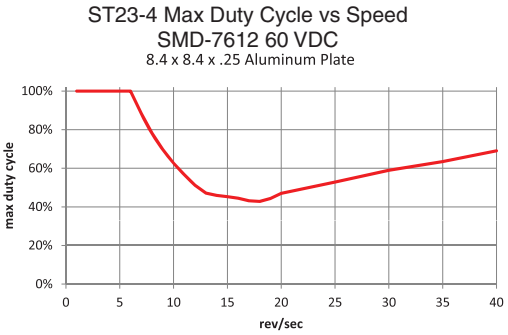


Figure 46. Duty Cycle for the ST23-6 with the SMD-7612 at 48 VDC

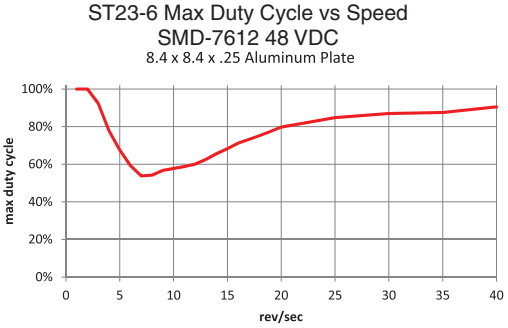


Figure 47. Duty Cycle for the ST23-6 with the SMD-7612 at 60 VDC

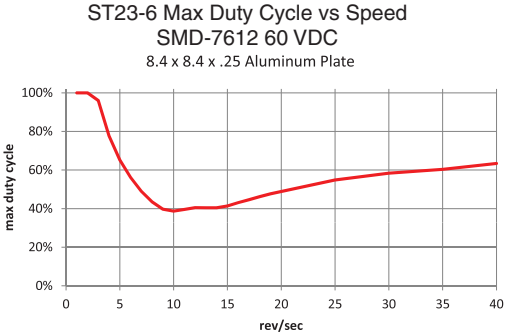


Figure 48. Duty Cycle for the ST23-8 with the SMD-7612 at 48 VDC

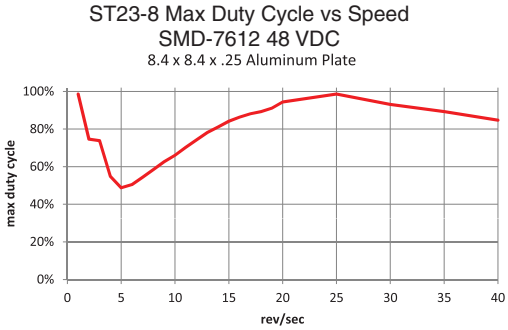


Figure 49. Duty Cycle for the ST23-8 with the SMD-7612 at 60 VDC

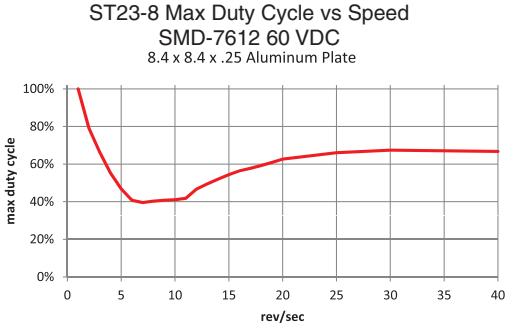


Figure 50. Duty Cycle for the ST24-1 with the SMD-7612 at 60 VDC

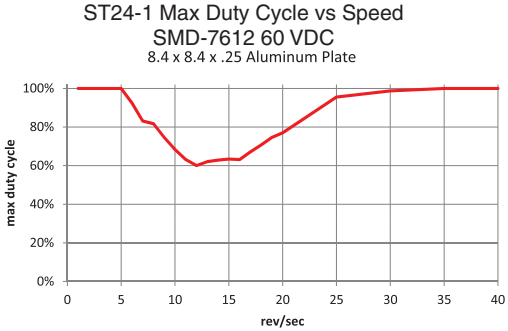


Figure 51. Duty Cycle for the ST24-2 at 48 VDC

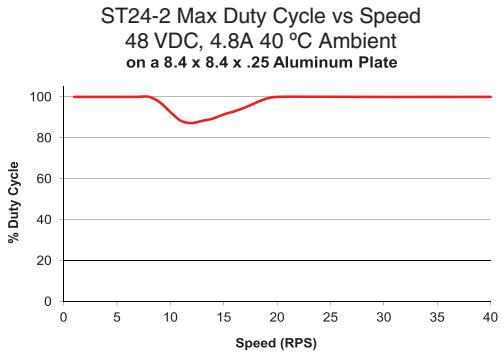


Figure 52. Duty Cycle for the ST24-2 with the SMD-7612 at 60 VDC

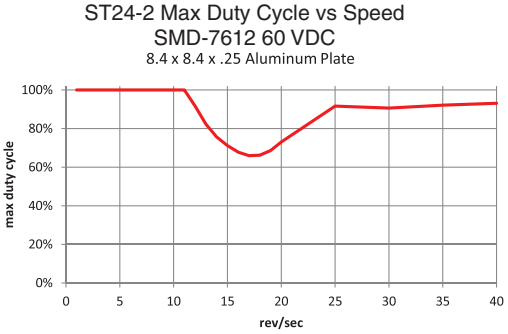


Figure 53. Duty Cycle for the ST24-3 at 48 VDC

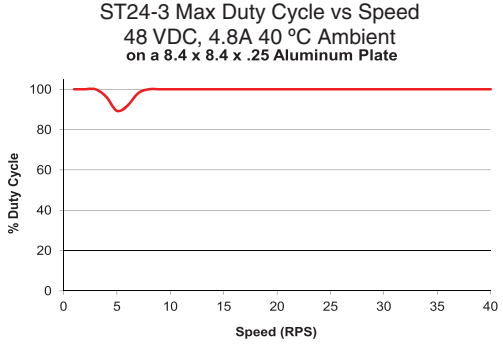


Figure 54. Duty Cycle for the ST24-3 with the SMD-7612 at 60 VDC

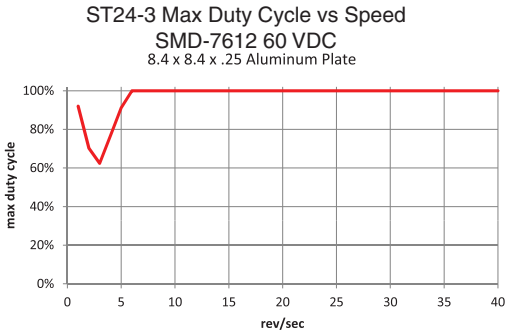


Figure 55. Duty Cycle for the ST34-2 with the SMD-7612 at 48 VDC

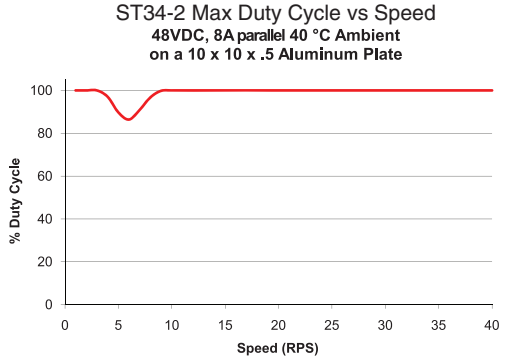


Figure 56. Duty Cycle for the ST34-2 with the SMD-7612 at 60 VDC

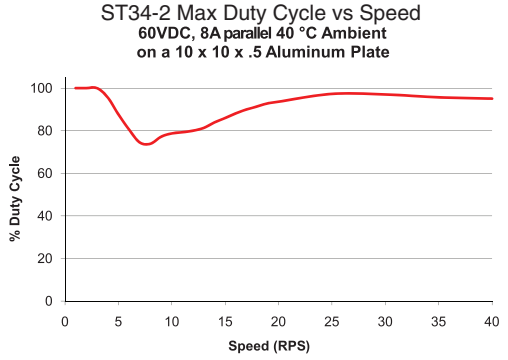


Figure 57. Duty Cycle for the ST34-5 at 24 VDC (Parallel Connection)

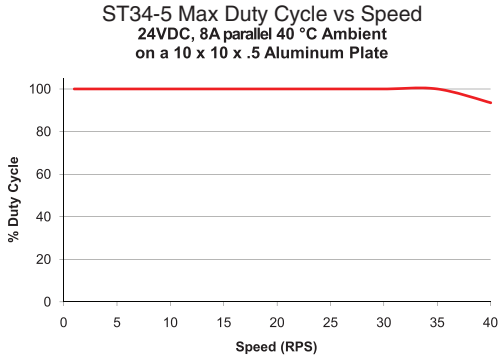


Figure 58. Duty Cycle for the ST34-5 at 48 VDC (Parallel Connection)

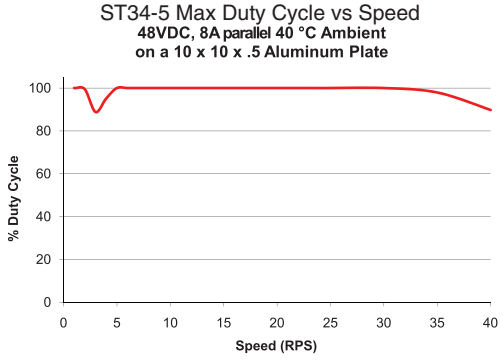


Figure 59. Duty Cycle for the ST34-5 at 60 VDC (Parallel Connection)

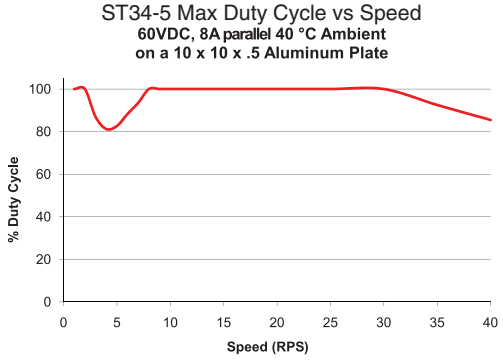


Figure 60. Duty Cycle for the ST34-5 at 24 VDC (Series Connection)

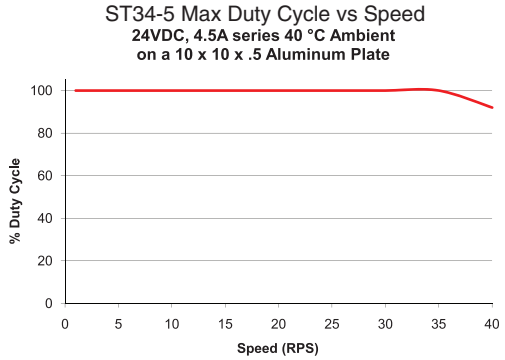


Figure 61. Duty Cycle for the ST34-5 at 48 VDC (Series Connection)

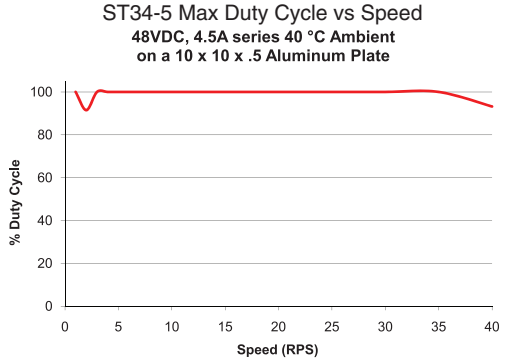


Figure 62. Duty Cycle for the ST34-8 at 24 VDC

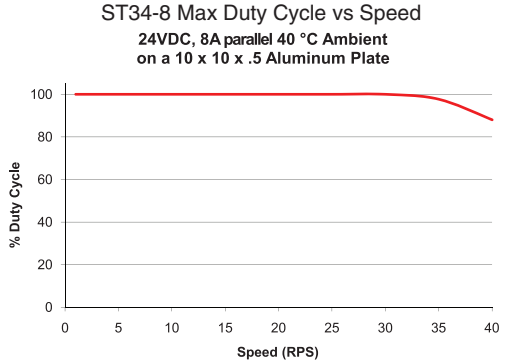


Figure 63. Duty Cycle for the ST34-8 at 48 VDC

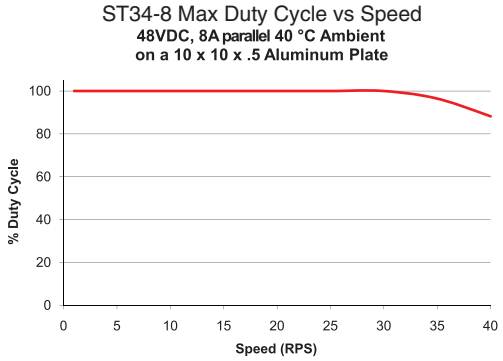


Figure 64. Duty Cycle for the ST34-8 at 60 VDC

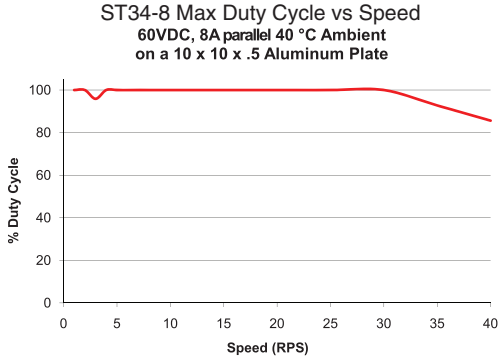
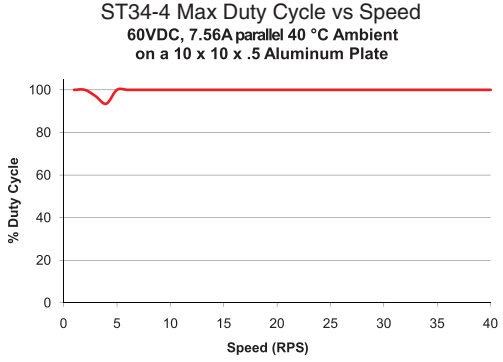


Figure 65. Duty Cycle for the ST34-4 at 60 VDC



Drive Heating

While NI SMD-7611/7612 devices efficiently transmit power between the power supply and motor, they do generate some heat in the process. This will cause the temperature of the drive to rise above the surrounding air temperature and may also require that the drive be mounted to a heat conducting metal surface.

To calculate the power dissipation and temperature rise, the following information is provided.

Given:

drive power dissipation P_d versus motor (refer to the figures below)

drive thermal constant R_Q

The final drive case temperature is given by:

$T_C = T_a + R_Q * P_d$

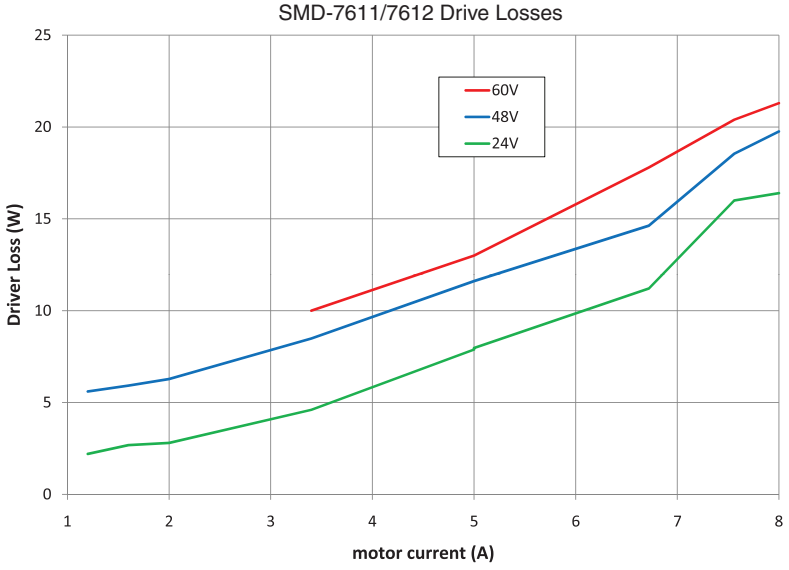
where T_a is the ambient temperature of the surrounding air. The case of the drive should not be allowed to exceed 70 °C or the life of the product could be reduced.

Drive thermal constant:

Narrow side of drive mounted on a 3.5” × 13.5” steel plate, 0.070 in. thick: $R_\theta = 1.0$ °C/W

Narrow side of drive mounted on a non-heat conducting surface: $R_\theta = 2.1$ °C/W

Figure 66. Drive Thermal Losses



Mechanical Outline

Figure 67. Mechanical Dimensions (Front View)

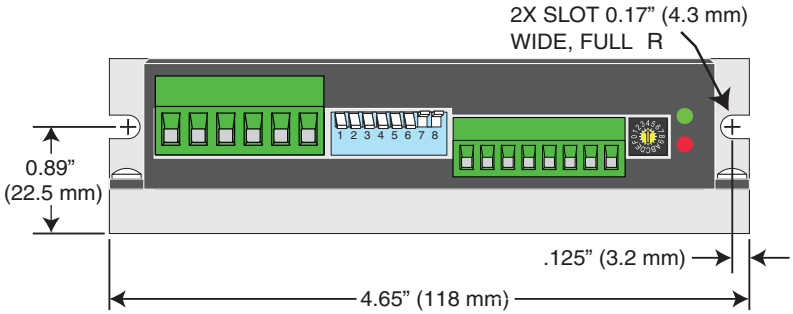


Figure 68. Mechanical Dimensions (Top View)

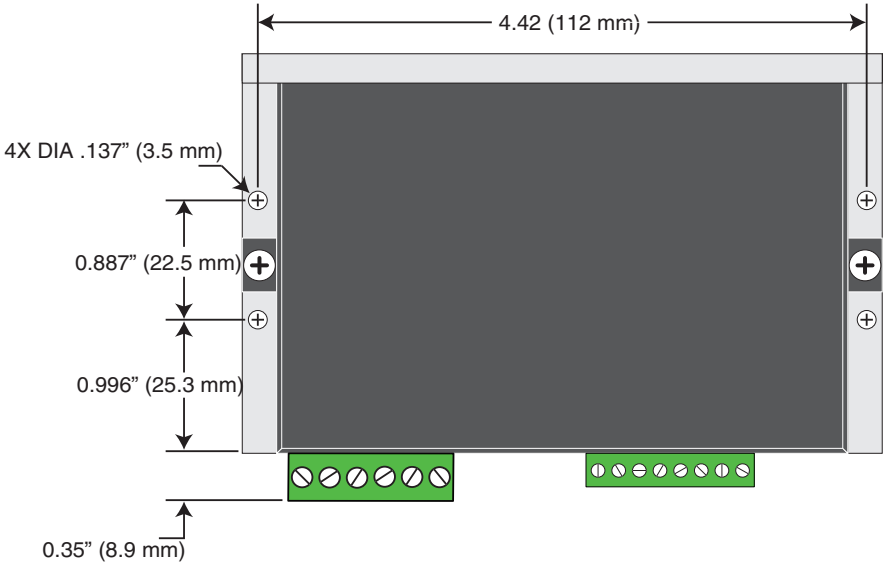
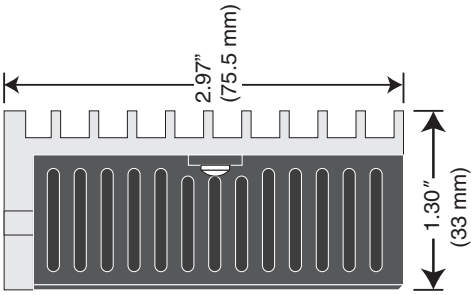


Figure 69. Mechanical Dimensions (Side View)



Technical Specifications

Amplifier

- Features: Digital MOSFET. 20kHz PWM. Suitable for driving two phase and four phase step motors with four, six, or eight leads.
- SMD-7611
  - Supply voltage: 12-48 VDC
  - Under voltage alarm: 20 VDC
  - Over voltage shutdown: 60 VDC
  - Motor current: 1.12 to 4.5 A/phase peak of sine, with rotary switch set to position 7 and current at 70%
- SMD-7612
  - Supply voltage: 24-60 VDC
  - Under voltage alarm: 20 VDC
  - Over voltage shutdown: 85 VDC
  - Motor current: 2.35 to 8 A/phase peak of sine, with rotary switch set to position 7 and current at 70%

Digital Inputs

- Isolation: Optically isolated, 5 to 24 V logic
- Digital logic levels: Minimum ON: 4 VDC
Maximum: 30 VDC
- Input current: 5 mA typical at 4 VDC
15 mA typical at 30 VDC
- Maximum pulse frequency: 150 kHz or 2 MHz (set by internal jumper)
- Minimum pulse width: 3 µsec at 150 kHz setting
0.25 µsec at 2 MHz setting

Fault output: Photodarlington, 80 mA, 30 VDC max.

- Voltage drop: 1.2 V max at 80 mA

Dimensions: 1.3 × 3.0 × 4.65 inches (33 × 75.5 × 118 mm)

Weight ..... 10.8 oz (305 g), including mating connectors

Operating temperature range ..... 0 °C to 50 °C

Mating connectors

- Motor/power supply ..... Phoenix Contact 1757051 (included)
- Signals ..... Phoenix Contact 1803633 (included)

Accessories

- Regeneration clamp ..... NI SMD-7700, NI part number 748908-01

Alarm Codes

In the event of an error, the green LED on the main board will flash one or two times, followed by a series of red flashes. The pattern repeats until the alarm is cleared.

Table 12. Status LED Blink Code Definitions

Blink sequence	Code	Error
G	Solid green	No alarm, motor disabled
GG	Flashing green	No alarm, motor enabled
RR	Flashing red	Configuration or memory error, contact NI support for assistance
RRRGG	3 red, 2 green	Internal voltage out of range
RRRRG	4 red, 1 green	Power supply voltage too high
RRRRGG	4 red, 2 green	Power supply voltage too low
RRRRRG	5 red, 1 green	Over current/short circuit
RRRRRRG	1 green, 6 reds	Open motor winding

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